View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by KnowledgeBank at OSU

Bivalve Mollusks from the Maxville Limestone (Mississippian) in Ohio

Richard D. Hoare [1], Department of Geology, Bowling Green State University, Bowling Green, OH 43403

Abstract. Bivalve mollusks are a common component of the Chesterian Maxville Limestone in Ohio, although not as abundant as the brachiopods. A number of taxa were found preserved as internal molds making identification difficult. The new species *Leptodesma* (*Leptodesma*) *rhysema*, *Limipecten lamellus*, *Astartella clinata*, and *Sanquinolites hekitoensis* are among the 29 taxa now known from the formation. The shale unit near the top of the formation contains mytilaceans and abundant pectenaceans dominated by *Aviculopecten winchelli* Meek, 1875, the latter with inarticulate brachiopod epibionts.

OHIO J SCI 107 (4): 63-75, 2007

INTRODUCTION

Collections from eight localities have produced a significant increase in the known bivalve fauna of the Mississippian (Chesterian) Maxville Limestone (Fig. 1). Previous work by Whitfield (1882, 1891, 1893), Morse (1911) and Hoare and others (1988) described seven taxa. An additional 22 taxa are included herein. Corrections of previous taxonomic assignments are given in the discussion on previous work and in the systematic section. The location of Whitfield's bivalve specimens is unknown, presumably lost. Six specimens collected by Morse are in the collections of the Orton Geological Museum, The Ohio State University. The purpose of this study is to describe and illustrate the known bivalve fauna and to update the taxonomic assignment of previously described taxa.

MATERIALS AND METHODS

Collections from the limestone and shale were obtained by the use of hammer and sledge in the field as well as finding weathered out specimens. Further preparation was done under a microscope using a vibratool and fine needles. In extracting specimens from the limestone the shell commonly adhered to the matrix and in chipping the matrix away from specimens the shell usually broke up as it was exposed. Samples of weathered limestone were boiled in a solution of water and Quaternary O which liberated numerous small specimens, mainly preserved as internal molds. Many of these were not well enough preserved to allow specific identification.

Specimens from the shale unit were all disarticulated valves. Shell material was preserved, although very thin and incomplete. These specimens were coated with a thin layer of Styrofoam dissolved in benzene to preserve the shell material and to protect the impression of the shell in the shale matrix.

All specimens were coated with a thin layer of magnesium oxide for photographic purposes to enhance the ornamentation. Photography was done with a Leica camera.

Collections made by the late M. T. Sturgeon and students, Ohio University, and the late A. S. Horowitz, Indiana University, were given to the author to supplement the collections at Bowling Green State University.

PREVIOUS WORK

The four species of bivalves described by Whitfield (1882, 1891, 1893) include: *Pinna maxvillensis* Whitfield = *Pinna* (*Sulcatopinna*) *missouriensis* Swallow, 1863; *Schizodus chesterensis* Meek and Worthen, 1860 = *Schizodus* sp.;*Allorisma andrewsi* Whitfield = *Wilkingia andrewsi* (Whitfield, 1882); and *Allorisma maxvillensis* Whitfield = *Wilkingia maxvillensis* (Whitfield, 1882). To this list Morse (1911) added one species: *Cypricardella oblonga* Hall, 1858a = *Edon oblonga* (Hall, 1858a). A short note by Hoare and others (1988) added two species in describing color patterns on *Aviculopecten winchelli* Meek, 1875, and *Streblopteria* sp. from the shale near the top of the Maxville.

Hyde (1953) described numerous Mississippian bivalves from Ohio but did not include the Maxvillle Limestone.

EPIFAUNA

The lack of shell material on most bivalve specimens precludes the preservation of any epibionts that may have been attached. The brachiopods in the Maxville Limestone have a common and varied epibiont fauna present on the shells (Hoare, 2003). It is likely that specimens of bivalves also had attached epibionts.

In several instances pedicle valves of *Orbiculoidea* cf. *O. keokuk* (Gurley, 1884) were found preserved on the valves of *Aviculopecten winchelli* Meek, 1875, in the upper black shale unit (Fig. 2.1-2.3) It is possible that the larvae of these inarticulate brachiopods suvived by becoming attached to the firm substrate of the bivalve shell. A brachial valve of *Oehlertella pleurites* (Meek, 1875) was also found in the shale but not on a bivalve shell (Fig. 2.4). Several small fragments of brachial valves were also found in the shale.

RESULTS

The bivalve fauna of the Maxville Limestone is much more diverse than previously known. An additional 22 taxa are described herein including:

Nuculopsis aff. *N. shumardana* (Hall, 1858a)
Nuculopsis sp.
Polidevcia cf. *P. stevensiana* (Girty, 1910)
Palaeoneilo sp.
Phestia cf. *P. pandoraeformis* (Stevens, 1858)
?*Solemya* (*Jania*) sp.
Modiolus (*Modiolus*) *fountainence* Weller, 1916
M. (*M.*) *waverliensis* (Herrick, 1888)
?ambonychiid gen. and sp.
Myalinella sp.
Leptodesma (*Leptodesma*) *rhysema* n. sp.
L. (*L.*) cf. *L.* (*L.*) *matheri* Elias, 1957
Aviculopecten sp. A
Aviculopecten sp. B
Limipecten lamellus n. sp.

[1] Corresponding author: Richard D. Hoare, Professor Emeritus, Department of Geology, Bowling Green State University, Bowling Green, OH 43402. Email: dhoare@bgnet.bgsu.edu

Limipecten sp.
Streblochondria sp.
Schizodus cf. *S. chesterensis* Meek and Worthen, 1860
Astartella clinata n. sp.
Edmondia sp.
Sanguinolites hekitoensis n. sp.
?*Sedgwickia* sp..

Two species of inarticulate brachiopods were found in the black shale unit, *Orbiculoidea* cf. *O. keokuk* (Gurley, 1884) and *Oehlertella pleurites* (Meek, 1875). These were presumably epibionts associated with pectenaceans. Further collecting will likely increase the number of bivalve taxa known in the Maxville Limestone.

SYSTEMATIC PALEONTOLOGY

The supergeneric classification of Newell (1969, p. N205) is followed and not reproduced herein. Specimens have been placed in the repository of the Orton Geological Museum, The Ohio State University (OSU).

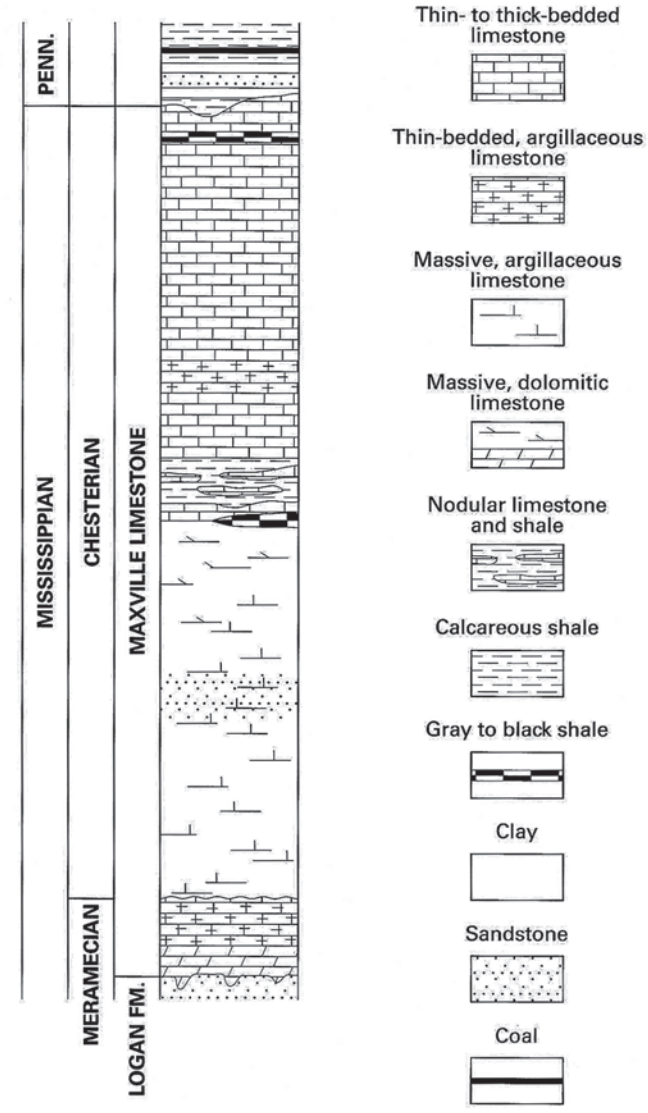

FIGURE 1. Generalized stratigraphic section of the Maxville Limestone in Ohio (modified in part from Scatterday (1963) and reprinted by permission of the Ohio Geological Survey).

Genus *Nuculopsis* Girty, 1911
Nuculopsis aff. *N. shumardana* (Hall, 1858a)
(Fig. 3.1-3.4)

Nucula shumardana Hall, 1858a, p. 16; Whitfield, 1882, p. 57, pl. 7, figs. 2-6; Hall, 1883, p. 343, pl. 30, figs. 2-6; Beede, 1906, p. 1323, pl. 23, figs. 2-6.

Description

Subtrigonal shell with beaks near anterior end; beaks prosogyrate extending above hingeline; hingeline slopes steeply to narrowly curved posterior margin; anterior margin truncate; surface with numerous closely-spaced, comarginal ridges; internal features not observed. Specimens range from 4.3 mm long, 3.8 mm high, 1.5 mm wide to 1.8 mm long, 1.4 mm high, 1.1 mm wide.

Discussion

One of the specimens has the shell preserved (Fig. 3.3), the rest are internal molds that are distorted to varying degrees. *Nucula shumardana* was described from the Salem Limestone in Indiana. The specimens from the Maxville Limestone differ from those in the Salem Limestone by being thicker and less truncate anteriorly with the beaks not located as far anteriorly. Otherwise they closely resemble Hall's species.

Material

Forty-nine specimens including OSU 52351-52353 from localities 2, 8.

Nuculopsis sp.
(Fig. 3.5-3.9)

Discussion

Several small internal molds have the basic shape of *Nuculopsis*. The beaks are prosogyrate. Muscle scars, pallial line, and dentition

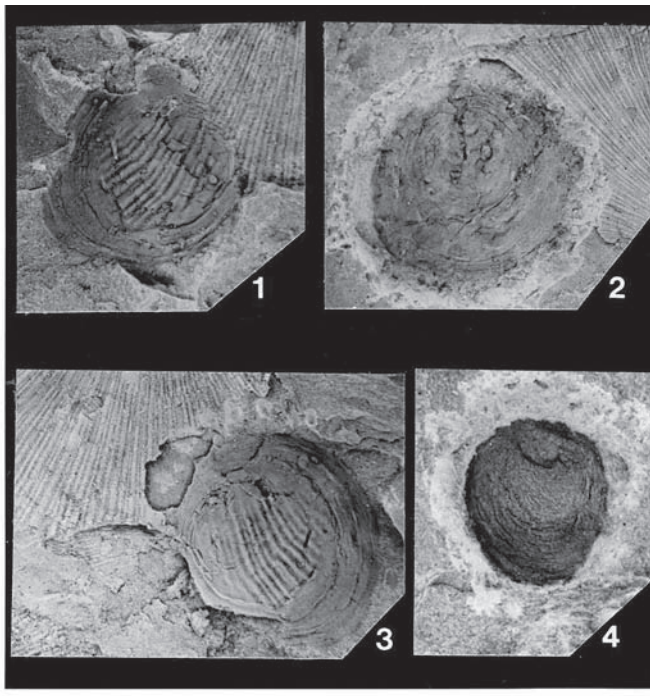

FIGURE 2. Presumed epibionts on pectenaceans. 1-3, *Orbiculoidea* cf. *O. keokuk* (Gurley), OSU 52424-52426, x2; 4, *Oehlertella pleurites* (Meek), OSU 52427,

are not preserved. They differ from *N. rectangular* (McChesney, 1860) by being more attenuate posteriorly and from *N. okawensis* Schenk, 1939 by being more elongate. The better preserved specimens range in size from 7.6 mm long, 5.1 mm high, 4.1 mm wide to 4.8 mm long, 3.7 mm high, 2.0 mm wide.

Material

Four internal molds including OSU 52354-52356 from localities 1, 2.

Genus *Polidevcia* Chernyshew, 1951
Polidevcia cf. *P. stevensiana* (Girty, 1910)
(Fig. 3.10-3.14)

Leda stevensiana Girty, 1910, p. 226.
Phestia stevensiana (Girty). Pojeta, 1969, p. 19, pl. 3, figs. 24-29.
Polidevcia stevensiana (Girty). Hoare, 1993, p. 378, fig. 2.17-2.21.

Description

Elongate, narrow, with nuculaniform shape; beaks anterior of midlength, low, incurved, prosogyrate; ornament and internal features not observed. Specimens range in size from 5.3 mm long, 2.8 mm high, 1.9 mm wide to 2.0 mm long, 1.1 mm high, 1.0 mm wide.

Discussion

Most of the specimens are small juveniles preserved as distorted internal molds.

Material

Over 100 specimens including OSU 52357-52359 from localities 1, 2.

Genus *Palaeoneilo* Hall and Whitfield, 1869
Palaeoneilo sp.
(Fig. 3.15-3.17)

Discussion

Fragments of two internal molds from the limestone and a compressed specimen from the shale unit, the latter showing the external ornamentation of fine comarginal lirae, are assigned to *Palaeoneilo*. They have the basic shape of the genus but the preservation does not allow specific assignment. *Palaeoneilo sera* Girty, 1910, from the Fayetteville Shale in Arkansas, is less produced posteriorly and the comarginal ornamentation is not as uniform as the specimens included here.

Material

Three specimens including OSU 52360-52362, from locality 1.

Genus *Phestia* Chernyshew, 1951
Phestia pandoraeformis (Stevens, 1858)
(Fig. 3.18, 3.19)

Leda pandoraeformis Stevens, 1858, p. 262.
Leda bellistriata Stevens. Winchell, 1862, p. 419; 1865, p. 128.
(non) *Leda pandoraeformis* Stevens. Hall, 1885, p. 332, pl. 47, figs. 49, 50; Girty, 1915, p. 84, pl. 8, figs. 15, 16.
Polidevcia pandoraeformis (Stevens). Driscoll, 1965, p. 79, pl. 10, figs. 16-34.
Phestia sp. Gordon and Henry, 1981, pl. 4, figs. 15, 16,.
Phestia pandoraeformis (Stevens). Hoare, 1993, p. 378, fig. 2.22-2.26.

Description

Small internal molds; beaks tightly incurved, anterior to midlength; strongly sloping posterodorsal margin; ventral margin convex becoming concave posteriorly; anterior margin broadly convex; internal features not observed. Specimens range in size from 4.3 mm long, 2.8 mm high, 2.0 mm wide to 2.0 mm long, 2.0 mm high, 1.4 mm wide.

Discussion

All of the specimens found are small internal molds and appear to be juveniles. They appear to be most similar to *P. pandoraeformis*. *Phestia nasata* (Hall, 1858) is somewhat similar but the beaks are located further posteriorly and the shell is less attenuate posteriorly.

Material

Sixteen specimens including OSU 52363 from localities 1, 2.

Genus *Solemya* Lamarck, 1818
Subgenus *Jania* King, 1850
Solemya (*Jania*) sp.
(Fig. 3.20)

Discussion

A single partial shell of a left valve shows characteristics distinguishing it from known Mississippian bivalves. The specimen was apparently elongate with a straight hingeline, with prosogyrate beaks close to the anterior extremity. The umbonal area is smooth but the ventral and posterior portions of the valve bear relatively coarse, closely-spaced costae radiating from the direction of the beak. One major comarginal growth line is present. The shell is partially distorted. Exact measurements cannot be made but the specimen is 12.6 mm long, 9.0 mm high, and 2.9 mm wide. It looks somewhat similar to *S.* (*J.*) *primaeva* Phillips, 1836, from the Carboniferous of England, although the costae are coarser and do not extend as far into the umbonal region.

Material

One incomplete left valve, OSU 52364, from locality 5.

Genus *Modiolus* Lamarck, 1799
Subgenus *Modiolus* Lamarck, 1799
Modiolus (*Modiolus*) *fountainensis* Weller, 1916
(Fig. 3.21-3.23)

Description

Small, thin shelled, narrowly elongately spatulate in form; beaks near anterior margin, not prominent; dorsal margin straight before curving with broad convexity into narrowly convex posterior margin; ventral margin nearly straight; anterior margin short, convex; surface with only faint comarginal growth lines; interior features not observed. Specimens range in size from 14.3 mm long, 6.2 mm high to 7.3 mm long, 3.7 mm high.

Discussion

The narrow, elongate shape and less prominent comarginal ornamentation distinguish *M.* (*M.*) *fountainensis* from other species of the subgenus.

Material

Three valves, OSU 52365-52367, from localities 1, 5.

Modiolus (*Modiolus*) *waverliensis* (Herrick, 1888)
(Fig. 3.24, 3.25)

Modiola waverliensis Herrick, 1888, p. 63, pl. 1, fig. 9, pl. 4, fig. 10 (not pl. 7, fig. 29); 1893, pl. 24, fig. 21,
Modiolus (*Modiolus*) *waverliensis* Herrick, Busanus and

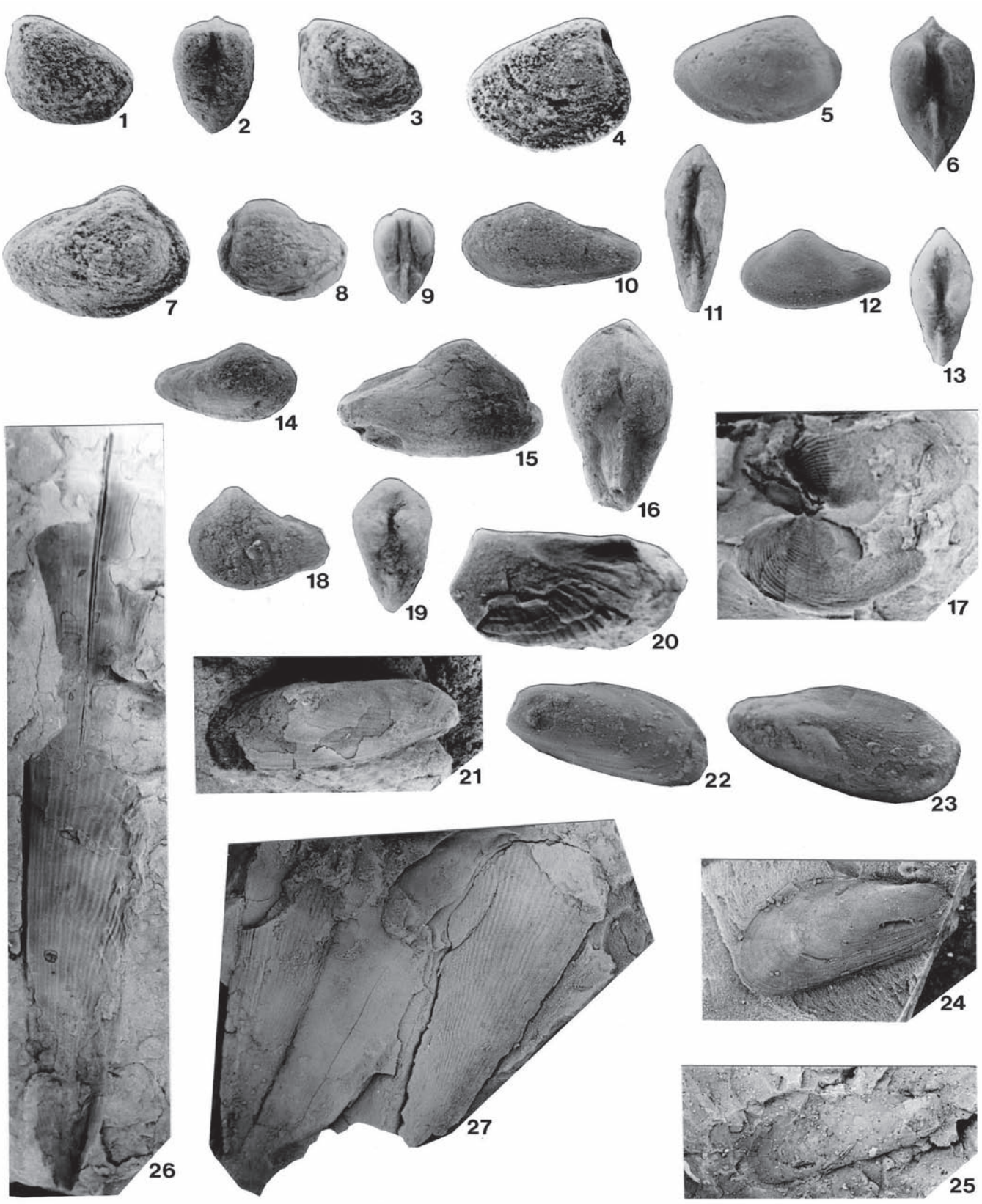

FIGURE 3. 1-4, *Nuculopsis* aff. *N. shumardana* (Hall). 1, 2, left valve and dorsal views, OSU 52351; 3, left valve view, OSU 52352; 4, right valve view, OSU 52353, loc. 1, x7. 5-9, *Nuculopsis* sp., 5, 6, right valve and dorsal views, OSU 52354 loc. 8, x4; 7, right valve view, OSU 52355, loc. 2, x7; 8, 9, left valve and dorsal views, OSU 52356, loc 1, x5. 10-14, *Polidevecia* cf. *P. stevensiana* (Girty). 10, 11, left valve and dorsal views, OSU 52357, x6; 12, 13, left valve and dorsal views, OSU 52358, x6; 14, right valve view, OSU 52359, x6, loc. 1. 15-17, *Palaeoneilo* sp. 15, 16, right valve and dorsal views, OSU 52360, x2; 17, composite view, OSU 52361, loc. 1, x6. 18, 19, *Phestia pandoraeformis* (Stevens), left valve and dorsal views, OSU 52363, loc. 1, x7. 20, ?*Solemya* (*Jania*) sp., left valve view, OSU 52364, loc. 5, x3. 21-23, *Modiolus* (*Modiolus*) *fountainense* Weller. 21, right valve view, OSU 52365, x3; 22, 23, two left valve views, OSU 52366, 52367, loc. 1, x6. 24, 25, *Modiolus* (*Modiolus*) *waverlyensis* (Herrick), two right valve views, OSU 52368, 52369, loc. 1, x2. 26, 27, *Pinna* (*Sulcatopinna*) *missouriensis* Swallow. 26, parts of two specimens, OSU 12199, loc. 7, x1; 27, parts of two valves, OSU 52370, loc. 1, x1.

Hoare, 1991, p. 467, fig. 3,15, 3.16; Hoare, 1993, p. 379, fig. 3.3-3.7.

Description

Small, thin-shelled, slightly inflated myalinid; beaks near anterior margin; hingeline straight; closely-spaced, comarginal growth lines present; hinge and internal features not observed. Better preserved specimen is approximately 20 mm long and 11 mm high.

Discussion

The specimens are from the shale unit preserved as internal molds with some shell material attached.

Material

Two right valves, OSU 52368, 52369, from locality 1.

Genus *Pinna* Linné, 1758

Subgenus *Sulcatopinna* Hyatt, 1892

Pinna (*Subcatopinna*) *missouriensis* Swallow, 1863

(Fig. 3.26, 3.27)

Pinna missouriensis Swallow, 1863, p. 97; Keyes, 1894, p. 116.

Pinna maxvillensis Whitfield, 1882, p. 221; 1891, p. 586, pl. 14, fig. 5; 1893, p. 474, pl. 10, fig. 5; Morse, 1911, p. 391, fig. 17.

Pinna arkansana Weller, 1897, p. 260, pl. 20, figs. 1, 2.

Sulcatopinna arkansana (Weller). Girty, 1915, p. 87, pl. 7, fig. 1.

Sulcatopinna missouriensis (Swallow). Weller, 1921, p. 375, pl. 11, fig. 1; 1931, p. 264, pl. 44, fig. 1; Busanus and Hoare, 1991, p. 468, fig. 3.24, 3.25; Hoare, 1993, p. 379, fig. 3.12.

Sulcatopinna sp. Gordon and Henry, 1981, pl. 4, fig. 20.

?pinnid Brezinski, 1989, pl. 3, fig. A.

Description

Elongate, narrowly triangular shell, subelliptical in cross section; beaks at anterior end; edentulous; ligament linear, subinternal, bordered by ridge externally along entire length; 25 or more elongate plicae radiating from beak area, some bifurcating; several growth lines in posterior half of length; no evidence of s smooth ventral portion, muscle scars, or nacre lobes. The largest fragmentary specimen is 10.5 cm long.

Discussion

Pinna arkansana and *P. maxvillensis* are believed to be synonyms of *P.* (*S.*) *missouriensis* based upon published descriptions and illustrations. *Pinna* (*S.*) *inexpectens* (Walcott, 1884) differs in having spine bases on the valves and *P.* (*S.*) *ludlovi* (Whitfield, 1876) has a smaller apical angle and grooved radial ribs.

Material

Three blocks of matrix of which two have several partial valves preserved, OSU 12199, 22911, 52370, from localities 1, 7, and one unknown locality.

?ambonychiid gen. and sp.

(Fig. 4.1-4.5)

Description

Internal mold with incurved, prosogyrate, gibbous beaks at anterior extremity; dorsal margin nearly straight curving sharply into posterior margin; ventral margin convex curving evenly into both anterior and posterior margins; anterior margin nearly vertical; faint impressions of comarginal growth lamellae; surface ornament and internal features not observed. The largest mold is 21.9 mm long, 19.0 mm high, 15.3 mm wide.

Discussion

The Ambonychiidae questionably range into the Mississippian (Newell and others, 1969, p. N285). The specimens described above have the general shape of the family and like *Gosseletia* Barrois, 1882, and *Mytilarca* Hall and Whitfield, 1869, lack indication of radial ornamentation on the internal molds. Some very small (2.0-4.0 mm long) internal molds may also represent the species. They do not add anything to the above descriptions.

Material

Two slightly distorted internal molds, OSU 52371, 52372, from locality 1.

Genus *Myalinella* Newell, 1942

Myalinella sp,

(Fig. 4.6, 4.7)

Description

Small, subrectangular, strongly prosocline shell; thin-shelled; beaks at anterodorsal margin; posterodorsal angle obtuse; faint comarginal growth lines; hinge and muscle scars not observed. Shells approximately 16 mm high.

Discussion

The specimens are from the black shale unit. They are incomplete and poorly preserved as internal molds with fragments of shell material present. Shell shape is similar to *Myalina monroensis* Weller, 1916, from the St. Genevieve Limestone in Illinois.

Material

Three valves, OSU 52373-52375, from locality 1.

Genus *Leptodesma* Hall, 1883

Subgenus *Leptodesma* Hall, 1883

Leptodesma (*Leptodesma*) *rhysema* n. sp.

(Fig. 4.8-4.12)

Diagnosis

Leptodesma with rounded ridge or fold within sulcus extending from umbonal area; surface ornament of narrow, comarginal, erect lamellae with wider interspaces.

Description

Hingeline straight; posterior margin strongly convex; anterior margin short, concave ventral to beaks becoming flatly convex before curving into broadly convex ventral margin; distinct, fairly deep sulcus radiating from umbonal area having a rounded fold within it in most specimens; surface ornament of numerous narrow, comarginal, erect lamellae which continue across sulcus and fold; hinge and internal features not observed. Specimens range in size from 10.6 mm long, 5.3 mm high to 19.3 mm long, 12.6 mm high.

Etymology

Greek, *rhysema*, wrinkle.

Discussion

The posterior wing in *L.* (*L.*) *rhysema* does not appear to be as extended posteriorly as in many other species of the genus (e.g. *L.* (*L.*) *matheri* Elias, 1957; *L.* (*L.*) *occidentalis* Girty, 1927). This may be a result of preservation or of preparation in uncovering the specimen in the limestone matrix. The sulcus may be deep or shallow and the ridge distinct to indistinct. The presence of the distinct ridge in the sulcus and the comarginal lamellae readily distinguish the species.

Material

Five valves, holotype OSU 52376, paratypes 52377-52380, from localities 1, 2.

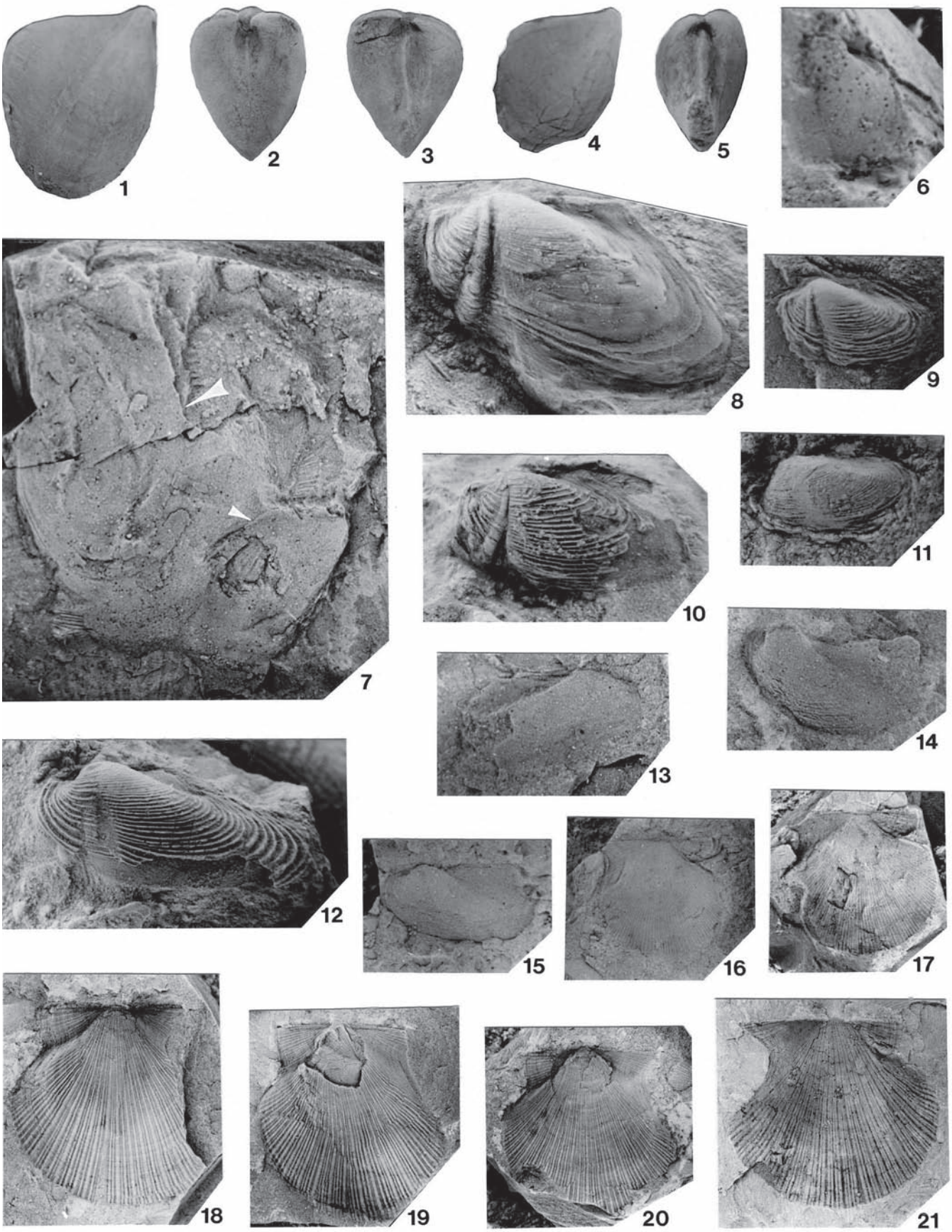

FIGURE 4. 1-5, ?ambonychiid gen. and sp. 1-3, right valve, anterior, and dorsal views, OSU 52371; 4, 5, right valve and dorsal views, OSU 52372, loc. 1, x1.5; 6, 7, *Myalinella* sp. 6, left valve view (large arrow), OSU 52373; 7, right valve view (small arrow), OSU 52375, loc. 1, x3. 8-12, *Leptodesma* (*Leptodesma*) *rhysema* n. sp. 8, holotype, left valve view, OSU 52376; 9-12, paratypes, four left valve views, OSU 52377-52380 respectively, loc. 1, x5. 13-15, *Leptodesma* (*Leptodesma*) cf. *L.* (*L.*) *matheri* Elias, right valve, left valve, left valve views, OSU 52381-52383 respectively, loc. 1, x3. 16-21, *Aviculopecten winchelli* Meek. 16, 17, two right valve views, OSU 52384, 52385; 18-21, four left valve views, OSU 52386-52389 respectively, loc. 1, x1.5.

Leptodesma (*Leptodesma*) cf. *L.* (*L.*) *matheri* Elias, 1957
(Fig. 4.13-4.15)

Monopteria? sp. Mather, 1915, p. 217, pl. 15, fig. 9.
Leptodesma (*Springeri*) *matheri* Elias, 1957, p. 761, pl. 92, figs. 1-8, pl. 93, figs 4, 5, text-figs. 1, 3-6.
Leptodesma sp. Gordon and Henry, 1981, pl. 4, fig. 23.
Leptodesma (*Leptodesma*) *matheri* Elias. Busanus and Hoare, 1991, p. 468, fig. 4.1, 4.2.
Leptodesma (*Leptodesma*) cf. *L.* (*L.*) *matheri* Elias. Hoare, 1993, p. 380, fig. 3.16.

Description

Hingeline straight; umbo extends above hingeline; beaks approximately one-fourth length from anterior margin; anterior margin short, convex, leading to concave area of posterior wing; surface ornament of numerous, closely-spaced lirae; internal features not observed. Specimens range in size from 10.0 mm long, 5.0 mm high to 11.5 mm long, 5.5 mm high.

Discussion

Although the specimens show some degree of distortion caused by compaction of the shale unit there is no indication of a sulcus and ridge in the anterior portion of the valve as in *L.* (*L.*) *rhysema* n. sp. The specimens described and illustrated by Elias (1957) are better preserved than those in the Maxville and the ornamentation is more sharply distinct.

Material

Numerous nearly complete to fragmentary valves including OSU 52381-52383 from locality 1.

Genus *Aviculopecten* McCoy, 1851
Aviculopecten winchelli Meek, 1875
(Fig. 4.16-4.21, 5.1, 5.2)

Aviculopecten winchelli Meek, 1875, p. 296, pl. 15, figs. 5a, b; Hoare, Hansen, Merrill and Hook, 1988, p. 653, fig. 1.1-1.4.

Description

Medium-sized, slightly prosocline suborbicular *Aviculopecten*; auricular sinuses moderately deep; body costae on left valve narrow, varying in size with one to three smaller costae between larger ones, increasing by intercalation; interspaces narrow; anterior auricle with 20-22 fine costae, posterior auricle with 15 fine costae; 62 body costae at distance of 25 mm from hinge line; numerous closely-spaced, comarginal growth lamellae; right valve with nearly equal-sized body costae separated by equal or narrower interspaces; anterior auricle with eight costae, posterior auricle with 19-20 finer costae; 87 body costae at a distance of 20 mm from hinge line; umbonal angle of 55 degrees; fine comarginal growth lines. Specimens measure up to 26 mm high and 26 mm wide.

Discussion

Hoare and others (1988) described specimens of this species from the black shale unit showing remnants of a color pattern. Examination of numerous other specimens has confirmed this assignment although they are slightly smaller than those described from the Waverly Group in Ohio and the costae are more prominent on the body of the right valve. In all other respects the specimens agree closely with the description by Meek (1875, p. 296).

Material

Nineteen specimens including OSU 37059-37062, 52387-52391 from locality 1.

Aviculopecten sp. A
(Fig. 5.3)

Description

Left valve small, suborbicular; 31 rounded body costae of unequal size, increasing by intercalation; costae crossed by fine, comarginal lamellae on posterior portion of valve; seven fine costae on left auricle with moderately deep sinus; umbonal angle of 97 degrees; other features not preserved. Specimens are 12.5 mm high, 11.0 mm wide.

Discussion

The specimens are immature and incomplete but retained shell material when extracted from the limestone matrix.

Material

Two left valves, OSU 52392, 52393, from locality 1.

Aviculopecten sp. B
(Fig. 5.4)

Description

Small, auricles set-off by deep sulci; 47 narrow body costae increasing by intercalation; interspaces narrow; nine fine costae on posterior auricle, 11 costae on anterior auricle; umbonal angle 88 degrees; numerous fine comarginal growth lines which become beaded crossing costae on anterior auricle; other features not observed. Specimen measures 6.6 mm high, 6.0 mm wide.

Discussion

The shell, a left valve, is nearly complete with the exception of portions of the auricles. It differs from *A. winchelli* Meek and *Aviculopecten* sp. A by having less distinct comarginal ornamentation, more closely-spaced body costae, and the umbonal area extends further above the hinge line.

Material

One left valve, OSU 52394, from locality 1.

Genus *Limipecten* Girty, 1904
Limipecten lamellus n. sp.
(Fig. 5.5, 5.6)

Diagnosis

Small *Limipecten* with nearly equal-sized, broadly rounded costae crossed by low, imbricate lamellae on the anterior portion of the valve.

Description

Small, valve convex, nearly orthocline; auricles incomplete, set-off from body by deep sulci; anterior auricle with eight flatly rounded costae, posterior auricle with nine to 10 smaller, flatly rounded costae; body with 40 broadly rounded, nearly equal-sized costae separated by narrower interspaces; costae increase by intercalation; costae crossed by numerous low, imbricate lamellae on anterior portion of valve; umbonal angle 98 degrees; right valve and interior features not observed. Specimens are 12-13 mm high, 11.5 mm wide.

Etymology

Latin, *lamina*, thin plate.

Discussion

Limipecten lamellus diffes from *L. docens* (McCoy, 1855), from the Lower Carboniferous of the United Kingdom, by having uniform-sized costae, coarser, more widely-spaced lamellae, and lack of lamellae on the umbonal area. The nature of the costae and imbricate lamellae distinguish this species.

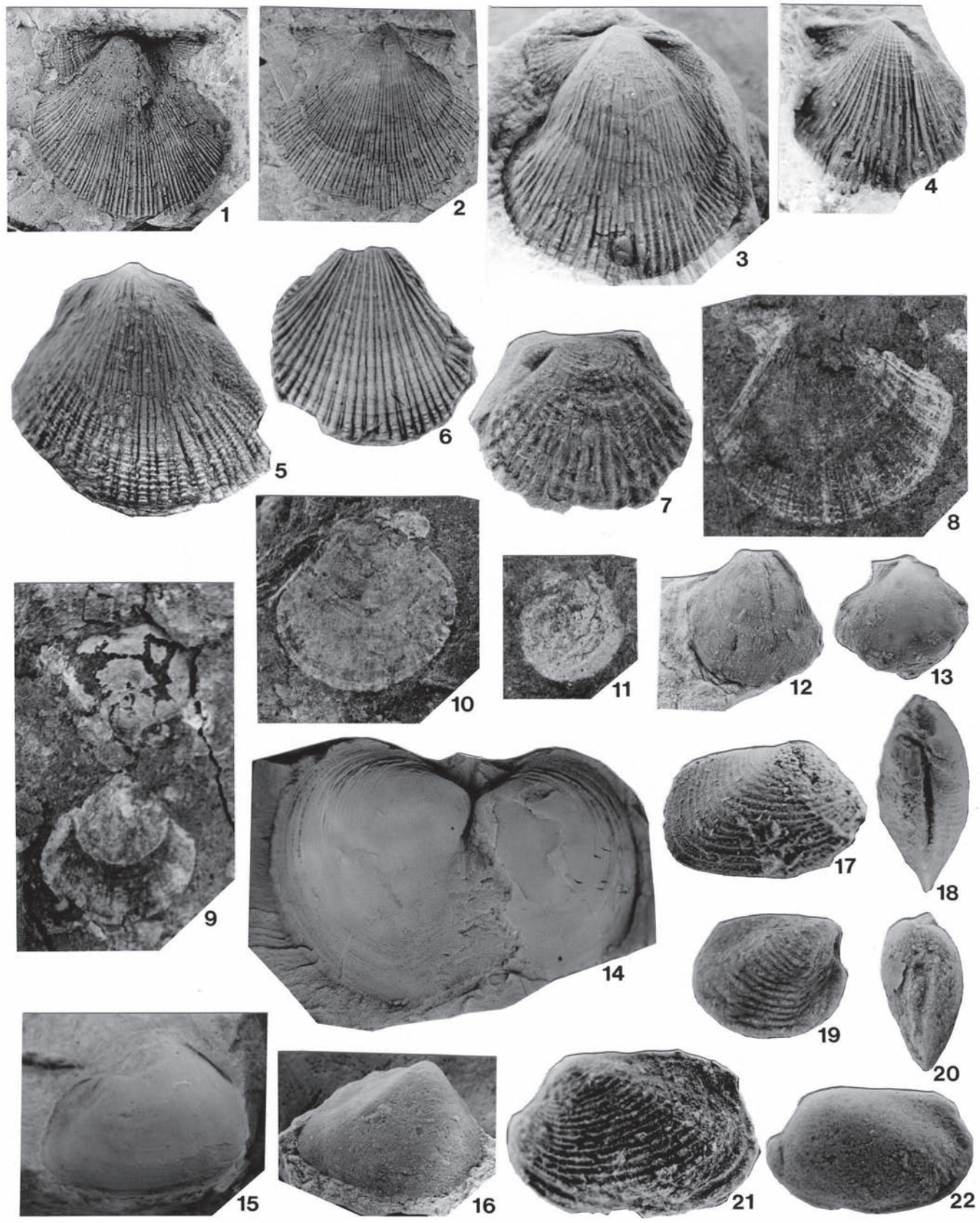

FIGURE 5. 1, 2, *Aviculopecten winchelli* Meek, two left valve views, OSU 52390, 52391, loc. 1, x1.5. 3, *Aviculopecten* sp. A, left valve view, OSU 52392, loc. 1, x4. 4, *Aviculopecten* sp. B, left valve view, OSU 52394, loc. 1, x5. 5, 6, *Limipecten lamellus* n. sp. 5, holotype, left valve view, OSU 52395, x4; 6, paratype, left valve view, OSU 52396, x3, loc. 1. 7, 8, *Limipecten* sp. two left valve views, OSU 52397, 52399, loc. 1, x6. 9, 10, *Streblochondria* sp., composite shell and left valve views, OSU 52400, 52401, loc. 1, x3, 11-13, *Streblopteria* sp., three right valve views, OSU 62402-52404 respectively, loc. 1, x3. 14, 15, *Schizodus* sp. 14, right valve view, OSU 52405, loc. 4, x1.5; 15, composite view, OSU 52406, loc. 1, x1.5. 16, *Schizodus* cf. *S. chesterensis* Meek and Worthen, right valve view, OSU 52407, loc. 1, x3. 17-22, *Edon oblonga* (Hall). 17,18, right valve and dorsal views, OSU 12202, loc. 6, x7; 19, 20, right valve and dorsal views, OSU 52408, loc. 1, x6; 21, left valve view, OSU 52409, loc. 1, x6; 22, left valve view of internal mold, OSU 52410, loc. 1, x8.

Material

Two left valves, holotype OSU 52395, paratype 52396, from locality 1.

Limipecten sp.
(Fig. 5.7, 5.8)

Discussion

Two small, incomplete, left valves from the limestone show characteristics of *Limipecten*. They differ from *L. lamellus* by having comarginal, imbricate lamellae from the umbo to the anterior margin. A specimen from the black shale unit may represent the same species. The largest specimen is 6.6 mm high, 7.5 mm wide.

Material

Three left valves, OSU 52397-52399, from locality 1.

Genus *Streblochondria* Newell, 1937
Streblochondria sp.
(Fig. 5.9, 5.10)

Discussion

Poorly preserved, somewhat distorted valves. Numerous ridges radiate from the umbonal area and are crossed by fainter comarginal ridges on the right valve. What may be a left valve (Fig. 5.9) lies in juxtaposition to a right valve, hinge line to hinge line, and is unornamented. The specimens may represent *S. tiltoni* Busanus and Hoare, 1991, but the preservation is too incomplete for a positive identification.

Material

Two partial specimens from the black shale unit, OSU 52400, 52401, from locality 1.

Genus *Streblopteria* McCoy, 1851
Streblopteria sp.
(Fig. 5.11-5.13)

Streblopteria sp. Hoare, Hansen, Merrill and Hook, 1988, p. 653, fig. 1.5-1.7.

Discussion

The fragmental nature of the specimens prevents a specific assignment. The smooth, orbicular-shaped shell and the obtuse angle of the posterior auricle places them in *Streblopteria*. Traces of a color pattern were found on some specimens. The most complete specimen is 9.0 mm long, 8.5 mm wide.

Material

Two partial left valves, OSU 52402, 52403, from locality 1.

Genus *Schizodus* de Verneuil and Murchson, 1844
Schizodus sp.
(Fig. 5.14, 5.15)

Schizodus chesterensis Meek and Worthen. Whitfield, 1891, p. 587, pl. 14, fig. 4; 1893, p. 474, pl. 10, fig. 4; Morse, 1911, p. 390, fig. 16.

Discussion

As noted by Elias (1957, p. 767) and Hoare and others (1989, p. 593) this specimen as described by Whitfield and Morse probably represents a new species. The lack of well preserved specimens precludes such an assignment. The illustration by Whitfield, repeated by Morse, and the present internal mold shows a significant difference in shape from *S. chesterensis* Meek and Worthen, 1860. The dorsoposterior region is more extended dorsally and the anterior margin is more strongly curved and produced further anteriorly in these limestone specimens. The composite mold from the black shale unit has a much stronger convexity of the ventral margin, a less produced anterior margin, and less strongly sloping umbonal ridge than the limestone mold or in *S. chesterensis*. It may represent a different species.

Material

Two specimens, OSU 52405, 52406, from localities 1, 4.

Schizodus cf. *S. chesterensis* Meek and Worthen, 1860
(Fig. 5.16)

Schizodus chesterensis Meek and Worthen, 1860, p, 451; 1866, p. 301, pl. 23, figs. 6a, b; ?Easton, 1942, p. 85, pl. 9, fig. 4; Elias, 1957, p. 767, pl. 96, fig. 10, text-figs/ 1.9, 1.10; Hoare, Heaney and Mapes, 1989, p. 593, fig. 5.19-5.22.

(non) *Schizodus chesterensis* Meek and Worthen. Whitfield, 1891, p. 587, pl. 14, fig. 4; 1893, p. 474, pl. 10, fig. 4; Morse, 1911, p. 390, fig. 16.

Discussion

A mold of the right valve appears to have the general shape of *S. chesterensis*. It is small, 11.6 mm long, 9.0 mm high, with a relatively strong posterior umbonal ridge extending towards the posteroventral margin. The posterior hingeline slopes strongly ventrally from the beak. A second specimen, collected by Morse (OSU 12198), is poorly preserved and may also represent this species.

Material

One specimen, OSU 52407, from locality 1.

Genus *Edon* Hall *in* Miller, 1877
Edon oblonga (Hall, 1858a)
(Fig. 5.17-5.22)

Cypricardella oblonga Hall, 1858a, p. 18; 1883, p. 340, pl. 30, figs. 30-34; Morse, 1911, p. 394, fig. 20.

Cypricardella nucleata Hall, 1858a, p. 17; 1883, p. 339, pl. 30, figs. 35, 36; Beede, 1906, p. 1331.

Microdon (*Cypricardella*) *oblonga* (Hall). Whitfield, 1882, p. 65, pl. 7, figs. 30-34.

Microdon oblonga (Hall). Beede, 1906, p. 1330, pl. 23, figs. 30-36.

Description

Shell elongate with straight dorsal margin sloping posteriorly; anterior margin concave below beaks then rounding sharply before curving convexly into ventral margin; posterior margin straight dorsally, curving convexly into ventral margin; beaks located anterior of midlength, tightly incurved, prosogyrate; valve angulated from umbo to ventroposterior margin; surface with comarginal growth lamellae; anterior muscle scar well developed, hinge not observed. Specimens range from 7.0 mm long, 4.3 mm high, 3.1 mm wide to 5.1 mm long, 4.1 mm high, 2.5 mm wide.

Discussion

As the name implies, *Edon oblonga* differs from other species of the genus by its elongate shape and by the posterior angulation of the valves. Smaller specimens are nearly equal in length and height as indicated by Whitfield (1882, p. 65) and Beede (1906, p. 1331).

Material

Twelve slightly distorted specimens including OSU 12202, 52408-52412, from localities 1, 6.

Genus *Astartella* Hall 1858b
Astartella clinata n. sp.
(Fig. 6.1-6.3)

Diagnosis

Small *Astartella* with convex posterodorsal margin sloping ventrally; short, convex, posterior margin; comarginal ridges and interspaces of equal size.

Description

Shell with strongly sloping dorsoposterior margin meeting short posterior margin with an obtuse angle; anterior margin convex; ventral margin flatly convex; valves angulated from umbonal area to ventroposterior margin; area dorsal to angulation concave; beaks tightly incurved near anterior margin, prosogyrate; lunule and escutcheon not deeply impressed; comarginal ridges become coarser during growth with equal-sized interspaces, eight in 2 mm near ventral margin; internal features not observed. The holotype is 9.6 mm long, 7.8 mm high, 4.4 mm wide.

Etymology

Latin, *clino*, slope, slant.

Discussion

Astartella clinata is most similar to the Pennsylvanian species *A. compacta* Girty, 1915, in terms of surface ornament but differs in the sloping dorsoposterior margin and shorter, less truncate, posterior margin. Other described species of *Astartella* have coarser comarginal ridges and do not have a sloping dorsoposterior margin.

Material

Two specimens, holotype OSU 52413, paratype 52414, from locality 1.

Genus *Edmondia* de Koninck, 1843
Edmondia sp.
(Fig. 6.10)

Discussion

A small internal mold of a left valve has a shape typical of the genus. The comarginal growth ridges are faintly preserved. *Edmondia? subplana* Hall, 1858a, differs by being more narrowly elongate with a less produced umbonal region and *E. equilateralis*

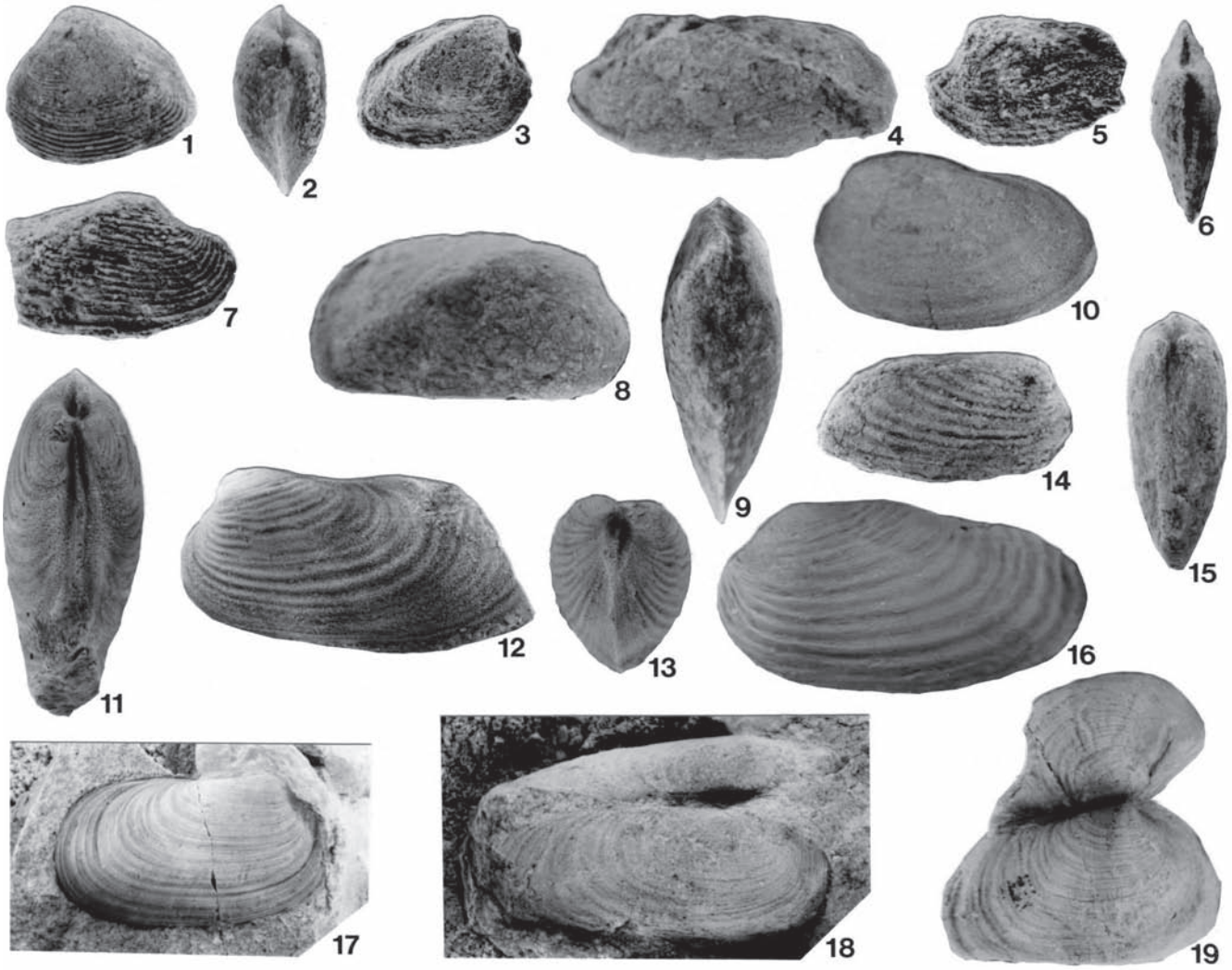

FIGURE 6. 1-3, *Astartella clinata* n. sp. 1, 2, holotype, left valve and dorsal views, OSU 52413; 3, right valve view, OSU 52414, loc. 1, x3. 4-9, *Sanguinolites hekitoensis* n. sp. 4, left valve view, OSU 52416, loc. 5, x3; 5, 6, left valve and dorsal views, OSU 52417, loc. 2, x5; 7, right valve view, OSU 52418, loc. 2, x5; 8, 9, holotype, right valve and dorsal views, OSU 52419, loc. 5, x4. 10, *Edmondia* sp., left valve view, OSU 52415, loc. 1, x3. 11-16, 18, *Wilkingia andrewsi* (Whitfield). 11-13, dorsal, left valve, and anterior views, OSU 12200, loc. 7, x1.5; 14, 15, right valve and dorsal views, OSU 52420, loc. 1, x2; 16, left valve view, OSU 52421, loc. 8, x2; 18, composite view, OSU 52422, loc. 5, x2. 17, *Wilkingia maxvillensis* (Whitfield), right valve view, OSU 22908, loc. 5, x2. 19, ?*Sedgwickia* sp., composite view, OSU 52423, loc. 3, x2.

Girty, 1910, has a much shorter shell. The specimen is 13.9 mm long, 9.5 mm high, 3.6 mm wide.

Material

One specimen, OSU 52415, from locality 1.

Genus *Sanguinolites* McCoy, 1844

Sanguinolites hekitoensis n. sp.

(Fig. 6.4-6.9)

Diagnosis

Small *Sanguinolites* with nearly parallel dorsal and ventral margins; umbonal shoulder rounded; ornamentation of strap-like, comarginal ridges.

Description

Small, narrow, elongate, subtrapezoidal shell; anterior margin narrowly convex, extended; dorsal and ventral margins nearly parallel; posterior margin truncate, flatly convex; beaks near anterior end, tightly incurved, prosogyrate; lunule and escutcheon present; umbonal ridge rounded, extending to ventoposterior margin; anterior and ventral area below umbonal ridge with numerous strap-like, comarginal growth ridges having steep edge dorsally; other features not preserved. Specimens range in size from 16.0 mm long, 7.2 mm high, 6.1 mm wide to 11.9 mm long, 6.4 mm high, 4.2 mm wide.

Etymology

Greek, *hekitos*, least.

Discussion

Sanguinolites hekitoensis differs from *S. uniformis* and *S. naidiformis*, both by Winchell, 1870, by having more uniform ornamentation and a rounded umbonal ridge. Sanguinolites *monroensis* (Worthen, 1884) has diverging ventral and dorsal margins and finer comarginal growth lines.

Material

Four specimens, holotype OSU 52419, paratypes 52416-52418, from localities 2, 5.

Genus *Wilkingia* Wilson, 1959

Wilkingia andrewsi (Whitfield, 1882)

(Fig. 6.11-6.16, 6.18)

Allorisma andrewsi Whitfield, 1882, p. 122; 1891, p. 588, pl. 14, fig. 6; 1893, p. 473, pl. 10, fig. 6; Morse, 1911, p. 392. fig. 18.

(non) *Allorisma andrewsi* Whitfield. Herrick, 1888, pl. 11, figs. 12a, b.

Description

Shell elongate, equivalved, dorsal and ventral margins subparallel; beaks rise above dorsal margin, tightly incurved, prosogyrate; posterior margin more broadly curved than anterior margin; greatest length below midheight, greatest width anterior of midlength; lunule and escutcheon present; valve surface with numerous broad, comarginal, rounded plicae commonly becoming coarser ventrally; some plicae bifurcate posteriorly; muscle scars and hinge not observed. Specimens range in size from 37.0 mm long, 17.4 mm high, 13.5 mm wide to 18.5 mm long, 9.2 mm high, 8.0 mm wide.

Discussion

The location of Whitfield's specimens is unknown and apparently lost. Two specimens collected by Morse are in the collections of the Orton Geological Museum. *Wilkingia andrewsi* is the most common bivalve found in the Maxville Limestone.

Material

Seventy complete and partial internal molds including OSU 12200, 12201, 52420-52422, from localities 1, 2, 5, 7, 8.

Wilkingia maxvillensis (Whitfield, 1882)

(Fig. 6.17)

Allorisma maxvillensis Whitfield, 1882, p. 82; 1891, p. 588, pl. 14, figs. 7, 8; 1893, p. 475, pl. 10, figs. 7, 8; Morse, 1911, p. 393, fig. 19.

Description

Elongate, equivalved shell; dorsal and ventral margins subparallel; anterior and posterior margins nearly equally convex; beaks extend above dorsal margin, located approximately one-fourth length from anterior margin; surface with numerous comarginal plicae with finer growth lines between plicae. Undistorted valve is 20.0 mm long and 12.0 mm high.

Discussion

Wilkingia maxvillensis differs from *W. andrewsi* in having less pronounced and less regularly distributed comarginal plicae, the beaks are located further from the anterior margin, and the posterior umbonal shoulder is weaker. The species is rare in the formation.

Material

One right valve with shell, OSU 22908, locality unknown.

Genus *Sedgwickia* McCoy, 1844

?*Sedgwickia* sp.

(Fig. 6.19)

Description

Medium-sized, gibbous shell; dorsal and ventral margins subparallel; ventral margin broadly convex; anterior and posterior margins subequally convex; beaks located one-third length posterior to anterior margin, incurved, prosogyrate; lunule and escutcheon not visible; broad, shallow sulcus extending from umbonal area to ventral margin posterior to midlength; surface with numerous closely-spaced, comarginal ridges with two to four finer ridges between coarser ridges; internal features not observed. Most complete valve is 19.0 mm long, 12.4 mm high.

Discussion

The shape and sulcus is somewhat similar to *Ectogrammysia* Hoare, Heaney and Mapes, 1989, but the comarginal ridges are much finer, of unequal size, and there is no evidence of bifurcation at or anterior to the sulcus. *Sphenotus aeolus* var. *curtus* Hyde, 1953, from the Logan Formation, which probably is a *Sedgwickia*, is similar in terms of the comarginal ornamentation, general shape, and size to the Maxville specimen.

Material

Internal mold of incomplete, partially spread valves, OSU 52423, from locality 3.

LOCALITIES

1. Abandoned Somerset Cut Limestone quarry on east side of County Road 96, 2.1 km north of Ohio Rte. 13, Hopewell Twp., Perry Co., NW1/4SW1/4, sec. 32, T17N, R16W, Somerset 7.5 minute quadrangle.

2. Maxville Stone Co. quarry on west side of Ohio Rte. 668, approx. 1.1 km north of Maxville, Monday Creek Twp., Perry Co., SW1/4, sec. 9, T14N, R16W, Junction City 7.5 minute quadrangle.

3. Exposure in tributary to Little Monday Creek near Ohio Rte. 668, 0.8 km north of Maxville, Monday Creek Twp., Perry Co., SE1/4SW1/4, sec. 9, T14N, R16W, Gore 7.5 minute quadrangle.

4. Exposure in gully at Mt. Perry Iron Bridge across Jonathon Creek, Madison Twp., Perry Co., SW1/4SW1/4, sec. 16, T17N, R15W, Fultonham 7.5 minute quadrangle.

5. Exposure in railroad cut near Wortman Iron Bridge across Jonathon Creek, Newton Twp., Muskingum Co., SE1/4 sec. 14, T17N, R15W, Fultonham 7.5 minute quadrangle.

6. Exposure in railroad cut along Jonathon Creek, Madison Twp., Perry Co., sec. 15, T17N, R15W, Fultonham 7.5 minute quadrangle.

7. Exposure below Kroft Bridge at White Cottage, Newton Twp., Muskingum Co., NE1/4, sec. 17, T15 N, R14W, Crooksville 7.5 minute quadrangle.

8. Abandoned quarry east of Poverty Run, Hopewell Twp., Muskingum Co., north of north line of sec. 12, T1N, R9W, Gratiot 7.5 minute quadrangle.

Acknowledgments. Collections at Ohio University, Indiana University, and The Ohio State University were made available for study by R. H. Mapes, the late A. S. Horowitz, and D. Gnidovec which were very helpful. M. C. Hansen, Ohio Geological Survey helped collect specimens from the black shale unit. Members of the author's family helped collect specimens from several localities. The continued support of the Department of Geology, Bowling Green State University is much appreciated.

LITERATURE CITED

Barrois CE. 1882. Mémoire sur la faune du gres amoricaine. Soc Géol du Nord, Ann 19:134-37.

Beede JW. 1906. Pelecypoda. In: Cummings ER Beede JW, Fauna of the Salem Limestone. Indiana Dept Geol 30th Ann Rep 1905. p 1323-34.

Brezinski DK. 1989. The Mississippian System in Maryland. Maryland Geol Surv Rept Invest 52. 75 p.

Busanus JW, Hoare RD. 1991. Bivalves (Mollusca) from the Mauch Chunk Group (Mississippian, Chesterian) of northern West Virginia and southwestern Pennsylvania. J Paleont 65:465-480.

Chernyshev BI. 1951. Semeistvo Ledidae iz Kamennougolnykh otlozhenii SSSR [The family Ledidae from the Carboniferous deposits of the USSR]. Akad Nauk Ukrainskoe SSR, Kiev, Instit Geol Nauk, Trudy, Ser Strat: Paleont 2:3-40.

Driscoll EG. 1965. Dimyarian pelecypods of the Mississippian Marshall Sandstone of Michigan. Paleontgr Americana 5:64-128.

Easton WH. 1942. Pitkin Limestone of northern Arkansas. Arkansas Geol Surv Bull 8. 89 p.

Elias MK. 1957. Late Mississippian fauna from the Redoak Hollow Formation of southern Oklahoma, Part 3, Pelecyopoda. J Paleont 31:737-784.

Girty GH. 1904. New mollusca genera from the Carboniferous. US Nat Mus Pr 27:721-36.

Girty GH. 1910. New genera and species of Carboniferous fossils from the Fayetteville Shale of Arkansas. New York Acad Sci Ann 20:189-238.

Girty GH. 1911. The fauna of the Moorefield Shale of Arkansas. US Geol Surv Bull 439. 148 p.

Girty GH. 1915. The fauna f the Batesville Sandstone of northern Arkansas. US Geol Surv Bull 593. 170 p.

Girty GH. 1927. Descriptions of Carboniferous and Triassic fossils. In: Mansfield GR, Geography, Geology, and Mineral Resources of Part of Southeastern Idaho. US Geol Surv Prof Paper 152. p 441-66.

Gordon M, Henry TW. 1981. Late Mississippian and Early Pennsylvanian invertebrate faunas, east-central Appalachians—a preliminary report. In: Roberts TG (ed.), GSA Cincinnati '81 Field Trip Guidebook 1: Stratigraphy. Sedimentology. Geol Soc America. p 165-71.

Gurley WFE. 1884. New Carboniferous fossils, no. 2. Private Pub, Danville, Illinois. 12 p.

Hall J. 1858a. Descriptions of new fossils from the Carboniferous limestones of Indiana and Illinois. Tr Albany Inst 4:1-36.

Hall J. 1858b. Paleontology of Iowa. Geol Surv Iowa, vol 1, pt. 2:473-724.

Hall J. 1883. [Spergen Hill fossils]. Indiana Dept Geol Ann Rept 12. p 319-375.

Hall J. 1885. Lamellibranchiata II, Descriptions and figures of the Dimyaria of the Helderberg and Chemung groups. New York Geol Surv, Paleo 5, pt. 1 p 269-561.

Hall J, Whitfield RP. 1869. Preliminary notice of the Lamellibranchiata shells of the upper Helderberg and Chemung groups, with others from the Waverly sandstones, pt. 1. Albany. 80 p.

Herrick CL. 1888. The geology of Licking County, Ohio, pt. 4. The Subcarboniferous and Waverly groups. Bull Sci Lab Denison Univ 3:13-110.

Herrick CL. 1893. Observations on the so-called Waverly Group of Ohio. Ohio Geol Surv 7. p 445-515.

Hoare RD. 1993. Mississippian (Chesterian) bivalves from the Pennsylvanian stratotype area in West Virginia and Virginia. J Paleont 67:374-96.

Hoare RD. 2003. Brachiopods from the Maxville Limestone (Mississippian) of Ohio. Ohio Geol Surv Rept Invest 147. 16 p.

Hoare RD, Hansen MC, Merrill GK, Hook RW. 1988. Preserved color patterns on Pectinacea (Bivalvia, Mississippian) from Ohio. J Paleont 62:653-54.

Hoare RD, Heaney III MJ, Mapes RH. 1989. Bivalves (Mollusca) from the Imo Formation (Mississippian, Chesterian) of north-central Arkansas. J Paleont 63:582-603.

Hyatt A. 1892. Remarks on the Pinnidaae. Boston Soc Nat Hist Pr 25:335-46.

Hyde JE. 1953. Mississippian Formations of Central and Southern Ohio. Ohio Geol Surv Bull 51. 355 p.

Keyes CR. 1894. Paleontologay of Missouri, pt.2. Missouri Geol Surv 5. 266 p.

King W. 1850. Permian fossils of England. Paleontgr Soc 1. 258 p.

Koninck LG de. 1843. Description des animaux fossils qui se trouvent dans le terrain carbonifère de Belgique. Liege. 651 p.

Lamarck JB de. 1799, Prodrome d'une nouvelle classification des coqiilles, comprenant une rédaction appropriée des charactères génériques, et l'établissement d'un grand nombre de genres nouveaux. Soc Hist Nat Paris, Mém 1. p 63-91.

Lamarck JB de. 1818. Histoire naturelle des animaux sans vertebras 5. Paris. 612 p.

Linné C. 1758. Systema naturae 10th ed vol 1. Holmiae, Stockholm. 823 p.

Mather KF. 1915. The fauna of the Morrow Group of Arkansas and Oklahoma. Bull Sci Lab Denison Univ 18:59-284.

McChesney JH. 1860. Descriptions of new species of fossils from the Paleozoic rocks of the western states. Extr Tr Chicago Acad Sci 1. 76 p.

McCoy F. 1844. A synopsis of the characters of the Carboniferous Limestone Fossils of Ireland. Dublin. 207 p.

McCoy F. 1851. Description of some new Mountain Limestone fossils. Ann Mag Nat Hist, 2nd ser 7:167-175.

McCoy F. 1855. A Systematic description of the British Palaeozoic fossils in the Geological Museum of the University of Cambridge. In: Sedgwick A, A Synopsis of the Classification of the British Palaeozoic Rocks. J. W. Parker, London. P 407-611.

Meek FB. 1875. A report on some of the invertebrate fossils of the Waverly Group and Coal Measures of Oho. Ohio Geol Surv vol 2 Paleont p 269-347.

Meek FB, Worthen AH. 1860. Descriptions of new Carboniferous fossils from Illinois and other western states. Acad Nat Sci Philadelphia Pr 1860 p 447-72.

Meek FB, Worthen AH. 1866. Descriptions of invertebrates from the Carboniferous System. Illinois Geol Surv 2, sec 2. p 143-411.

Miller SA. 1877. American Paleozoic Fossils: a catalogue of the genera and species. Cincinnati, Ohio. 253 p.

Morse WC. 1911. The fauna of the Maxville Limestone. Ohio State Acad Sci Pr 5(7):352-420.

Newell ND. 1937. Late Paleozoic Pelecypods: Pectinacea. Kansas Geol Surv vol 10 pt 1, 123 p.

Newell ND. 1942. Late Paleozoic Pelecypods: Mytilacea. Kansas Geol Surv vol 10 pt 2, 80 p.

Newell ND. 1969. Classification of the Bivalvia. In: Moore RC (ed.), Treatise on Invertebrate Paleontology Pt N Mollusca 6(1). Geol Soc America and Kansas Univ Press. Lawrence. p 205-18.

Newell ND, LaRocque A, Pojeta J. 1969. Family Ambonychiidae. In: Moore RC (ed.), Treatise on Invertebrate Paleontology Pt N Mollusca 6(1). Geol Soc America and Kansas Univ Press. Lawrence. p N285.

Phillips J. 1836. Illustrations of the geology of Yorkshire, pt 2, The Mountain limestone district. John Murray, London. 253 p.

Pojeta Jr J. 1969. Revision of some of Girty's invertebrate fossils from the Fayetteville Shale (Mississippian) of Arkansas and Oklahoma. US Geol Surv Prof Paper 606-C p C15-C24.

Scatterday JW. 1963. Stratigraphy and conodont faunas of the Maxville Group (Middle and Upper Mississippian) of Ohio. Unpub PhD dissert Ohio State Univ. 162 p.

Schenck HG. 1939. Revised nomenclature for some nuculid pelecypods. J Paleont 13:21-41.

Stevens RP. 1858. Descriptions of new Carboniferous fossils from the Appalachian, Illinois, and Michigan coal fields. American J Sci 25:258-65.

Swallow GC, 1863. Descriptions of some new fossils from the Carboniferous and Devonian rocks of Missouri. Tr St. Louis Acad Sci 2:81-100.
Verneuil PEP de, Murchison RI. 1844. Note sur le équivalents de système permien en Europe, suivie d'un coup d'oeil général sur l'ensemble de ses fossils, et d'un tableau des spèces. Soc Geol France Bull 2nd ser 1. 505 p.
Walcott CD. 1894. Paleontology of the Eureka District. Fossils of the Carboniferous. US Geol Surv Mono 8. p 212-67.
Weller JM. 1931. The Mississippian fauna of Kentucky. In: Jillson WR, The Paleontology of Kentucky. Kentucky Geol Surv 36. p 251-90.
Weller S. 1897. The Batesville Sandstone of Arkansas. Tr New York Acad Sci 16:251-82.
Weller S. 1916. Description of a Ste. Genevieve Limestone fauna from Monroe County, Illinois. Walker Mus Univ Chicago Contr 1(16):243-264.
Whitfield RP. 1876. Descriptions of new species of fossils. In: Ludlow W, Report of a Reconnaisance from Carroll, Montana Territory, on the Upper Missouri to the Yellowstone National Park and Return, Made in the Summer of 1875. Washington D.C. p 139-45.
Whitfield RP. 1882. Descriptions of new species of fossils from Ohio with remarks on some of the geological formations in which they occur. New York Acad Sci Ann 2:193-244.
Whitfield RP. 1891. Species from the Maxville Limestone, the equivalent of the St. Louis and Chester limestones of the Mississippi Valley. New York Acad Sci Ann 5:576-95.
Whitfield RP. 1893, Contributions of invertebrate paleontology. Ohio Geol Surv 7. p 407-94.
Wilson RE. 1959. *Wilkingia* gen. nov. to replace *Allorisma* for a genus of upper Paleozoic lamellibranches. Palaeont 1:401-04.
Winchell A. 1862. Descriptions of fossils from the Marshall and Huron Groups of Michigan. Philadelphia Acad Nat Sci Pr 1862:405-30.
Winchell A. 1865. Descriptions of new species of fossils from the Marshall Group of Michigan, and its supposed equivalent in other states; with notes on some fossils of the same age previously described. Philadelphia Acad Nat Sci Pr 1865:109-33.
Winchell A. 1870. Notices and descriptions of fossils from the Marshall Group of the western states, with notes on fossils from their formations. American Philos Soc Pr 11:245-60.
Worthen AH. 1884. Descriptions of two new species of Crustacea, fifty-one species of Mollusca, and three species of crinoids, from the Carboniferous formations of Illinois and adjacent states. Illinois State Mus Nat Hist Bull 2. 27 p.